CHEMISTRY

Q1.

A solid has face centered cubic unit cell. If the radius of the anion is 241.5 pm, the radius of the cation is

(a) 150 pm
(b) 195 pm
(c) 190 pm
(d) 90 pm

Q2.

The rate constant of a chemical reaction at 280K is $1.6 \times 10^{-6}\ s^{-1}$. The activation energy of this reaction is zero. The value of k for this reaction at 300K is

(a) $1.6 \times 10^{-4}\ s^{-1}$
(b) $1.6 \times 10^{-5}\ s^{-1}$
(c) $1.6 \times 10^{-6}\ s^{-1}$
(d) Zero

Q3.

CH_4 (g) + CuO(s) → CO_2(g) + 4Cu(s) + $2H_2O$ (I) for the above reaction at 298 K, ΔH°_{r} in kJ (I) are respectively – 74.9, - 157.3, -393.5 and -285.9 is. The standard enthalpy change in kJ mol^{-1} would be

(a) -1670
(b) -261
(c) +1670
(d) +261

Q4.

A system at equilibrium is described by the equation

Heat + SO_2CI_2 (g) ⇌ SO_2 (g) + CI_2(g) + CI_2 (g) the addition of CI_2 in the reaction mixture

(a) Increases the temperature
(b) decreases the temperature
(c) has not effect on temperature
(d) decreases the volume

Q5.

A solution of naphthalene in benzene has a mole fraction of naphthalene equal to 0.10. What is the molality of the solution?

(a) 2.3 m
(b) 1. 42 m
(c) 3. 1 m
(d) 1.9 m

Q6.

Polarisability of halide ions increases in the order

(a) F^-, CI^-, Br^-, I^-
(b) CI^-, I^-, Br^-, F^-
(c) I^-, Br^-, CI^-, F^-
(d) I^-, CI^-, Br^-, F^-

Q7.

The coagulation of 10 ml of gold solution is just prevented by an addition of 1 ml of 10% NaCI in the presence of 0.025 g. of starch. The gold number of starch is:

(a) 0.25
(b) 0.025
(c) 25
(d) 250

Q8.

The total energy of a Bohr's orbit is proportional to (n = Principal quantum number)

(a) n^2
(b) 1/n
(c) n
(d) $1/n^2$

Q9.

Consider the following equilibrium: $NH_4HS\ (s) \rightleftharpoons NH_3\ (g) + H_2S\ (g)$ choose the correct relation:

(a) $Kp = Kc\ (RT)^1$
(b) $Kp = Kc\ (RT)^2$
(c) $Kp = Kc\ (RT)^3$
(d) $Kp = Kc$

Q10.

The reaction in a fuel cell is : $H_2 + ½O_2 \rightarrow H_2O$ $E°(O_2, H^+, H_2O) = 1.229$ V. The emf of the cell is

(a) Zero
(b) – 1.229 V
(c) 1.229 V
(d) 0.059 log 1.229

Q11.

The number of significant figures in 0.00046100 are

(a) 3
(b) 8
(c) 5
(d) 6

Q12.

A compound was found to contain 10.5% by weight of nitrogen. The minimum molecular weight of the compound would be

(a) 89.5
(b) 133.3
(c) 100
(d) 175

Q13.

The boiling point of a pure liquid is 353.23 K. When 1.80 g of a non-volatile solute is dissolved in 90 g of this pure liquid, the boiling point becomes 354.11 K. The molar mass of the solution is (given that the boiling point elevation constant function of the pure liquid is 2.53 K. kg. mol^{-1})

(a) 1.7 $g.mol^{-1}$
(b) 25 $g.mol^{-1}$
(c) 5.4 $g.mol^{-1}$
(d) 58 $g.mol^{-1}$

Q14.

Thomson performed his famous “cathode ray tube” experiment, and came to the conclusion that

(a) Under ordinary conditions of temperature and pressure gases in general are good conductors of electricity
(b) The value of ‘e/m’ of the electrons, as determined in the experiment depends on the nature of the gs I the tube.
(c) The value of ‘e/m’ of the electrons as determined in the experiment depends on the nature of the cathode used.
(d) The colour of the “light” observed in the experiment depended on the nature of the gas in the tube.

Q15.

$C_4H_6O_4 \xrightarrow{\Delta} C_3H_6O_2 \xrightarrow[\Delta]{sodalime} C_2H_{6*}$ (A) is

(a) $CH_3-CH(COOH)_2$
(b) $\begin{array}{l} CH_2COOH \\ | \\ CH_2COOH \end{array}$
(c) Both correct
(d) none is correct.

Q16.

For the preparation of p - nitroiodobenzene from p – nitroaniline, the best method is:

(a) $NaNO_2$/ HCI followed by KI
(b) $NaNO_2$ / HCI followed by CuCN
(c) $LiAIH_4$ followed by I_2.
(d) $NaBH_4$ followed by I_2.

Q17.

The composition of brown ring obtained during the qualitative detection of nitrates with ferrous sulphate and sulphuric acid corresponds to:

(a) $[Fe(H_2O)_5\ NO]^{3+}$
(b) $[Fe(H_2O)5NO]^{2+}$
(c) $[Fe(H_2O)_5NO]^{+}$
(d) $[Fe(H_2O)_5NO]$

Q18.

The reaction between benzldehyde and formaldehyde in the presence of conc. NaOH gives

(a) $C_6H_5COONa + CH_3OH$
(b) $C_6H_5CH_2OH + HCOONa$
(c) $C_6H_5\ CH_2\ OH + C_6\ H_5COONa$
(d) $CH_3\ OH + HCOONa$

Q19.

Which of the following is used as an antiseptic?

(a) Dettol
(b) Bithional
(c) Iodine
(d) All of these

Q20.

Which of the following is not soluble in nitric acid?

(a) PbS
(b) HgS
(c) CuS
(d) CdS

Q21.

Of the five isomeric hexanes, the isomer which can give two monochlorinated compounds is:

(a) n – Hexane
(b) 2, 3 – Dimethyl butane
(c) 2, 2 – Dimethyl butane
(d) 2- Methylpentane

Q22.

Schiff's reagent give pink colour with:

(a) Acetaldehyde
(b) Acetone
(c) Acetic Acid
(d) Methyl acetate

Q23.

Which of the following statements is true for structure of sucrose:

(a) C – 1 of glucose is linked to C – 2 of fructose by α – glycosidic linkage.
(b) C – 1 of glucose is linked to C – 2 of fructose by ß – glycosidic linkage.
(c) C – 1 of glucose is linked to C – 4 of fructose by α – glycosidic linkage.
(d) C – 1 of glucose is linked to C – 4 of fructose by ß – glycosidic linkage.

Q24.

On adding a few drops of dil, HCI to freshly precipitated ferric hydroxide, a red coloured colloidal substance is obtained. This phenomenon is called.

(a) Peptisation
(b) Dialysis
(c) Dissolution
(d) Coagulation

Q25.

Which of the following statement is false?

(a) Gas molecules travel in straight line between collisions.
(b) For an ideal gas, PV is always constant at all pressures.
(c) 1.0 g. of H_2 and 1.0 g. of O_2 contain equal number of molecules at STP.
(d) Proportinal to square root of its molecular mass

Q26.

A metal salt when subjected to charcoal cavity test gives a shining metallic bead that marks paper. This indicates the presence of salt of :

(a) Ag
(b) Pb
(c) Cu
(d) Sulphate

Q27.

The roasting of mercuty sulphide in the air in metallurgical process produces

(a) HgO
(b) Hg
(c) $HgSO_3$
(d) $HgSO_4$

Q28.

Which of the following is a bent non-linear molecule?

(a) OF_2
(b) BeF_2
(c) CO_2
(d) CS_2

Q29.

Which of the following organo – metallic compound is used in Zeigler – Natta catalyst for polymerization of ethylene ?

(a) $(CH_3)_3$ AI
(b) $(C_2H_5)_2 TiCI_2$
(c) B $(CH_3)_3$
(d) Li[Al $(CH_3)_4$]

Q30.

Xanthoprotein test is given by:

(a) Phenylalanine
(b) Tyrosine
(c) Tryptophan
(d) All of these

PHYSICS

Q1.

Each sid of cube is 7.203 cm. The total surface area and volume of cube can be expressed as

(a) 311.2 cm^2, 373.7 cm^3
(b) 311.179 cm^2, 373. 715 cm^3
(c) 311.17 cm^2, 374 cm^3
(d) 311.5 cm^2, 373.67 cm^3

Q2.

Parabolic path of a projectile as seen by another similar projectile is

(a) A parabola
(b) Circle
(c) Ellipse
(d) Straight line

Q3.

A rocket is ejecting 0.05 kg of gases per second at a velocity of 400 ms^{-1}. The accelerating force on the rocket i

(a) 20 dyne
(b) 20 N
(c) 22 N
(d) 4000 N

Q4.

A gun requiring the support of shoulder shows intensive recoil when fired with

(a) The butt held tightly with the shoulder
(b) The butt held loosely against the shoulder
(c) Butt held loosely or tightly against the shoulder
(d) A bullet of greater mass

Q5.

Three metallic balls, each of radius r, are placed touching each other on a horizontal plane such that the line joining their centres form an equilateral triangle. The centre of mass of system is located at

(a) Centre of one of balls
(b) Point of intersection of medians
(c) Horizontal plane
(d) Line joining any two centres of balls

Q6.

A large number of particles of same mass m are kept at horizontal distances of 1m, 2m, 4m, 8m and so on from (0, 0) point. The total gravitational potential at this point is

(a) – 8Gm
(b) – 3 Gm
(c) – 4 Gm
(d) – 2 Gm

Q7.

A sphere contracts in volume by 0.01% when taken to the bottom of sea 1 km deep. The bulk modulus of the sphere is

(a) 6.7×10^{10} Nm^{-1}
(b) $8 .1 \times 10^{10}$ Nm^{-1}
(c) 8×10^{8} Nm^{-1}
(d) 9.8×10^{10} Nm^{-1}

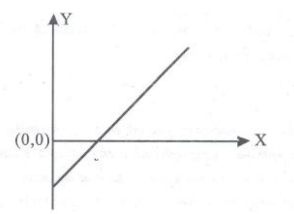
Q8.

If an isotropic solid has coefficients of linear expansion α_x, α_y and α_z for three rectangular axis in the solid, the coefficient of Volume expansion for solid is

(a) $\alpha_z \alpha_y \alpha_z$
(b) $\alpha_z / \alpha_y + \alpha_z$
(c) $\alpha_z + \alpha_y + \alpha_z$
(d) $\alpha_z^2 + \alpha_y^2 + \alpha_z$

Q9.

Expansion of a unit mass of an ideal gas at constant pressure is shown in the figurr.



(a) X is volume axis and Y is temperature axis
(b) X is pressure axis and Y is temperature axis
(c) X is temperature axis and Y is volume axis
(d) Y is volume axis and X is temperature axis

Q10.

The acceleration due to gravity on the surface of a satellite is 1.5 m^{-2}. The time period of a simple pendulum on it, if is time period on the earth is t, will be

(a) Infinite
(b) 3.5 t
(c) 4.8 t
(d) 2.56 t

Q11.

If the amplitude of a damped oscillator becomes half in 2 minutes, the amplitude or oscillations w.r.t. intial amplitude after 6 minutes is

(a) 1/27
(b) 1/8
(c) 1/18
(d) 1/64

Q12.

Three charges Q, +q and +q are placed on the vertices of an equilateral triangle of side I. If the net electrostatic energy of the system is zero then Q is equal to

(a) $-q^2 / 2$
(b) $-q$
(c) $+q^2$
(d) Zero

Q13.

An electric kettle has two heating elements. One brings it to boil in 10 minutes and the other in 15 minutes. If the two elements are connected in parallel, the water in the kettle will boil in

(a) 8 Minutes
(b) 6 Minutes
(c) 5 Minutes
(d) 25 Minutes

Q14.

A 36Ω galvanometer is shunted by a resistance of 4Ω. The percentage of total current passing through the galvanometer is

(a) 91 %
(b) 10 %
(c) 9 %
(d) 8 %

Q15.

A photon and a deuteron moving with equal kinetic energies enter perpendicularly into a magnetic field. If r_p and r_d are the respective raddi of the circular path, the ratio r_P/r_d is

(a) 1
(b) $\sqrt{2}/1$
(c) $1/\sqrt{2}$
(d) ½

Following questions are based on paragraph. First go through the paragraph and then answer the question A solenoid of resistance 50 Ω and inductance 80 H is connected to a 200V battery. It takes time t for the current to reach 50% of its final value.
Now answer the following questions:

Q16.

Time t in seconds is

(a) 2.22
(b) 1.11
(c) 3.33
(d) 4.44

Q17.

Maximum energy stored is

(a) 460 J
(b) 604 J
(c) 640 J
(d) 406 J

Q18.

A parallel plate capacitor of area 60 cm^2 and separation 3 mm is charged initially to 90?C. if the medium between the plate gets slightly conducting and the plate loses the charges initially at the rate of 2.5x 10^{-8} Cs^{-1}, the magnetic field between the plates is

(a) Infinite
(b) Zero
(c) 1 μA
(d) 1.392 μA

Following question consists of two statements printed as Statement 1 and Statement 2. While answering these questions you are required to select any one of the response indicates as

1. **If both Statement 1 and Statement 2 are true and Statement 2 is a correct explanation Statement 1.**
2. **If both Statement 1 and statement 2 are true but the Statement 2 is not a correct explanation of Statement 1.**
3. **If statement 1 is true but the statement 2 is false.**
4. **If Statement 1 is false but Statement 2 is true.**

Q19.

Statement 1: When radius of curvature of a spherical mirror is increased its focal length remains unchanged.

Statements 2: Radius of curvature of a plan mirror is infinite.

(a) 1
(b) 2
(c) 3
(d) 4

Q20.

According to Cauchy's inferences, ay increase in wavelength results into

(a) No change in refractive index, μ being a scalar
(b) Increase in refractive index, μ being a tensor
(c) Decrease in refractive index, μ
(d) None of these

Q21.

Sound travelling at 340 ms^{-1} enters water where the speed sound becomes 1480 ms^{-1}.Critical angle for total internal reflection is

(a) 10.3°
(b) 13.3°
(c) 1.03°
(d) 1.33°

Q22.

If frequency of K_α X-ray emitted from the element with atomic number 31 is v, then the frequency of K_α X – rays emitted from the element with atomic number 51 would be

(a) $\frac{3}{25}\ v$
(b) $\frac{25}{9}\ v$
(c) $\frac{3}{5}\ v$
(d) $\frac{5}{3}\ c$

Q23.

A source of half life 2 hours emit radiations of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is

(a) 12 hours
(b) 18 hours
(c) 24 hours
(d) 6 hours

Q24.

The ratio kinetic energy to the total energy of an electron in Bohr orbit is

(a) 1 : - 1
(b) -1 : 1
(c) 1 : 2
(d) 2 : - 1

Q25.

If l_1, l_2, l_3 are the lengths of the emitter, base and collector of a transistor, then

(a) $l_1 = l_2, = l_3$
(b) $l_3, < l_2, < l_1$
(c) $l_3 < l_1, < l_2$
(d) $l_3, > l_1, > l_2$

Q26.

The requirement of transmitting microwaves from one position to another on the earth is that

(a) The transmitting and receiving antennas must be in line of sight
(b) The satellite remains fixed at a point w.r.t. the earth
(c) Wavelength of electromagnetic waves
(d) Frequency of electromagnetic waves must be 10^{-6} Hz

Q27.

A proton, a deuteron and an alpha particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of trajectories of these particles, then

(a) $r_\alpha = r_p < r_d$
(b) $r_\alpha > r_p > r_d$
(c) $r_\alpha = r_d > r_p$
(d) $r_\alpha = r_p = r_d$

Q28.

A satellite S is moving in an elliptical orbit around the earth. The mass of satellite is very small compared to the mass of the earth, then

(a) The acceleration of S is always directed towards the centre of the earth
(b) The angular momentum of s about the centre of the earth changes in direction, but its magnitude remains constant
(c) The total mechanical energy of s varies periodically with time
(d) The linear momentum of S remains constant in magnitude

Q29.

A wind powered generator converts a fixed fraction of wind energy intercepted by its blades into electric energy. For wind speed v, the electrical power output will be proportional to

(a) v
(b) v^2
(c) v^3
(d) v^4

Q30.

Two particles A and B initially at rest, move towards each other by mutual force of attraction. At the instant when the speed of A is v and the speed of B is 2v , the speed of mass of the system is

(a) 3v
(b) V
(c) 1.5v
(d) Zero

MATHEMATICS

Q1.

The domain of the $f(x) = \sqrt{\log_{10}\left(\frac{5x-x^2}{4}\right)\ is}$

(a) [1, 4]
(b) [1, 0]
(c) [0, 5]
(d) [5, 0]

Q2.

The period of $\sin^2 \theta$ is

(a) π^2
(b) π
(c) 2π
(d) $\frac{\pi}{2}$

Q3.

The number of real roots of $3^{2x^2-7x+7} = 9\ is$

(a) 0
(b) 2
(c) 1
(d) 4

Q4.

If w is an imaginary cube root of unity, then $(1 + w - w^2)^7$ equals

(a) 128w
(b) – 128w
(c) $128w^2$
(d) $-128w^2$

Q5.

If w is a cubic root of unity, then $\begin{vmatrix} 1 & 1+i+w^2 & w^2 \\ 1-i & -1 & w^2-1 \\ -i & -1+w-i & -1 \end{vmatrix}$ *equals*

(a) 0
(b) 1
(c) i
(d) w

Q6.

If $A = \begin{vmatrix} a & b \\ b & a \end{vmatrix}$ and $A^2 = \begin{bmatrix} \alpha & ß \\ ß & \alpha \end{bmatrix}$, then

(a) $\alpha = a^2 + b^2$, $ß = ab$
(b) $\alpha = a^2 + b^2$, $ß = 2ab$
(c) $\alpha = a^2 + b^2$, $ß = a^2 - b^2$
(d) $\alpha = 2ab$, $ß = a^2 + b^2$

Q7.

If ${}^{n}C_r$ denotes the number of combinations of n things taken r at a time, then the expression ${}^{n}c_{r+1} + {}^{n}c_{r-1} + 2\,{}^{n}c_r$ equals

(a) ${}^{n+2}c_r$
(b) ${}^{n+2}c_{r+1}$
(c) ${}^{n+1}c_r$
(d) ${}^{n+1}c_{r+1}$

Q8.

The number of ways in which 6 men and 5 women can dine at a round table, if no two women are to sit together is given by

(a) 6! x 5!
(b) 30
(c) 5! x 4!
(d) 7! x 5!

Q9.

Let $S(k) = 1 + 3 + 5 \ldots\ldots + (2k - 1) = 3 + k^2$, then which of the following is true

(a) S(1) is correct
(b) $S(k) \Rightarrow S(k+1)$
(c) $S(k) \nRightarrow S(k+1)$
(d) Principle of mathematical induction can be used to prove the formula.

Q10.

If $|x| < 1$, then the coefficient of x^n in the expression of $(1 + x + x^2 + x^3 + \ldots\ldots)^2$ is

(a) n
(b) $n - 1$
(c) $n + 2$
(d) $n + 1$

Q11.

If x is positive, the first negative term in the expression of $(1 + x)^{27/5}$ is

(a) 7th term
(b) 5th term
(c) 8th term
(d) 6th term

Q12.

$e^{x-\frac{x^2}{2}+\frac{x^2}{3}-\frac{x^4}{4}+\cdots\cdots}$ is equal to

(a) log x
(b) log (x + 1)
(c) 1 + x
(d) None of these

Q21.

A straight line through the point (2, 2) intersects the lines $\sqrt{3}x - y = 0$ and $\sqrt{3}$ x – y = 0 at the point A and B. The equation to the line AB so that ΔAOB is equilateral is

(a) x – 2 = 0
(b) y – 2 = 0
(c) x + u – 4 = 0
(d) None of these

Q22.

The equation of the plane containing the line $\frac{x-x_1}{t} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$ is

a (x – x_1) + b (y – y_1) + c (z – z_1) = 0, where

(a) $ax_1 + b + by_1 + cz_1 = 0$
(b) al + bm + cn = 0
(c) $\frac{a}{l} = \frac{b}{m} = \frac{c}{n}$
(d) $lx_1 + my_1 + nz_1 = 0$

Q23.

The shortest distance from plane 12x + 4y + 3z = 327 to the sphere

$x^2 + y^2 + z^2 + 4x - 2y - 6z = 155$ is

(a) 26
(b) $11\frac{4}{13}$
(c) 13
(d) 39

Q24.

The vector $\hat{\imath} + x\hat{\jmath} + 3\,\hat{k}$ is rotated through an angle θ and doubled in magnitude, then it becomes $4\hat{\imath} + (4x - 2)\,\hat{\jmath} + \ 2\,\hat{k}$. The value of x are

(a) $-\frac{2}{3}, 2$
(b) $\frac{1}{3}, 2$
(c) $\frac{2}{3}, 0$
(d) $2, 7$

Q25.

Given two vectors are $\hat{\imath}$ - $\hat{\jmath}$ and $\hat{\imath} + 2\hat{\jmath}$. The unit vector coplanar with the two vectors and perpendicular to first is

(a) $\frac{1}{\sqrt{2}}\,(\hat{\imath} + \hat{\jmath})$
(b) $\frac{1}{\sqrt{5}}(2\hat{\imath} + \hat{\jmath})$
(c) $\pm\frac{1}{\sqrt{2}}(\hat{\imath} + \hat{\jmath})$
(d) None of these

Q26.

If $\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix} = 0$ and vectors $(1, a, a^2)$, $(1, b, b^2)$ and $(1, c, c^2)$ are non coplanar, then the product abc equals

(a) 2
(b) -1
(c) 1
(d) 0

Q27.

Let $\vec{u} = \hat{\imath} + \hat{\jmath}, \hat{v} = \hat{\imath} - \ \hat{\jmath}$ and $\vec{w} = \hat{\imath} - \ \hat{\jmath}$ and $\overrightarrow{w} = \hat{\imath} + \ 2\hat{\jmath} + \ 3\hat{k}$. If $\hat{n}$ is a unit vector such that $\vec{u}.\hat{n} = 0$ and $\vec{v}.\hat{n} = 0$, then $|\vec{w}.\,\hat{n}|$ is equal to

(a) 0
(b) 1
(c) 2
(d) 3

Q28.

If A and B are two mutually exclusive events, then

(a) P (A) $<$ P ($\bar{B}$)
(b) P (A) $>$ P ($\bar{B}$)
(c) P (A) $<$ P ($\bar{B}$)
(d) None of these

Q29.

A problem in mathematics is given to three students A, B, C and their respective probability of solving the problem is $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$, The probability that problem is solved is

(a) 3/4
(b) 1/2
(c) 2/3
(d) 1/3

Q30.

Tan$^{-1}\left(\frac{1}{2}\right)$ tan$^{-1}\left(\frac{1}{3}\right)$ is equal to

(a) tan$^{-1}\left(\frac{1}{6}\right)$
(b) tan$^{-1}\left(\frac{1}{7}\right)$
(c) tan$^{-1}\left(\frac{1}{5}\right)$
(d) None of these